

AMENDMENT UNDER 37 C.F.R. § 1.111
U.S. Application No.: 09/904,097

REMARKS

Claims 13-19 are all the claims pending in the application. Claims 1-12 and 20 have been cancelled. Applicants reserve the right to file a divisional application directed to the cancelled subject matter.

Election/Restrictions

Claims 1-12 stand withdrawn from further consideration as being drawn to a nonelected invention. As stated above, Claims 1-12 are now cancelled.

Drawings

The drawings filed on September 24, 2001 are objected to because reference character “300” has been used to designate both “an exposed area” and “an encapsulating material”, in Figures 7 and 9. The drawings are also objected to because they include the reference sign “3” which is not mentioned in the description. The drawings are also objected to because certain figures are said to be improperly crosshatched.

Applicants respond as follows.

Applicants have relabeled reference character “300” in Fig. 9 designating “an exposed portion” as reference character “301” which is not used in any other diagram. Applicants have also submitted a corresponding amendment to the specification at page 28, line 14, and submitted corrected drawings in this response to the Office Action.

Additionally, the specification at page 34, line 4, has been amended to designate the underfill material as reference number “300” in Fig. 7.

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The specification has been amended to insert a paragraph starting on page 34, starting at line 8, to identify in Fig. 7 a metal cover pad (170), a semiconductor die made of silicon (280), and metallic connecting pads (290). The identity of these elements is obvious from the FC-PGA type multi-layer printed wiring board on which a semiconductor element is mounted as is shown in Fig. 7 and therefore no new matter is introduced.

Furthermore, the second full paragraph beginning at line 4 on page 7 of the specification has been amended to insert reference character “3” before “an inside (wall) surface of a hole” at line 5 on page 7.

As to cross-hatching of all parts shown in section, corrected drawings have been submitted with this response along with a Request for Approval of Proposed Drawing Corrections.

It is believed that all drawings, and references in the specification to the drawings, are now in compliance with the MPEP. Accordingly, Applicants respectfully request withdrawal of the objections to the drawings.

Claim Rejections -35 USC § 112

Claims 13-20 stand rejected under 35 U.S.C. 112, second paragraph, as allegedly being indefinite for failing to particularly point out and distinctly claim the subject matter which Applicants regard as the invention.

A. The Examiner asserts that with regard to Claim 13, it is not clear what are the structural elements of the final invention. There are several elements that are claimed, which

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exist only in the stages of making the device, and are not necessarily present in the final product. For example: the curing agent in line 6. In addition it is further unclear, if the recitation: "an alkyl group containing 1 to 10 carbon atoms, a hydroxyalkyl [sp] group containing 1 to 10 carbon atoms or an alkyloxy group containing 1 to 10 carbon atoms", is merely reciting possible constituents in the imidazolic compound or if these are additional constituents of the paste.

Applicants respond as follows.

Applicants point to disclosure in the specification, e.g., at pages 8-9. It is clearly understood in Claim 13 that the recitation of "an alkyl group containing 1 to 10 carbon atoms, a hydroxyalkyl group containing 1 to 10 carbon atoms or an alkyloxy group containing 1 to 10 carbon atoms" relates to substituents represented by R₁ in the imidazolic compound and NOT to additional constituents of the paste.

In order to advance prosecution of this application, Applicants have amended Claim 13 to use a Markush grouping to more clearly define their claimed invention. Furthermore, Applicants have amended claim 13 to more clearly recite that the throughhole is filled with a cured throughhole-filling material, and that the cured throughhole-filling material comprises, in admixture, a cured paste of an epoxy resin, a curing agent and a metal filler.

B. The Examiner asserts that with regard to Claim 16, it is not clear what is the structural limitation stated in the claim; therefore, the Examiner treats the claim as being a product-by-process limitation.

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Applicants agree that this is a product-by-process limitation but traverse that it is nonetheless patentable for reasons given in other sections of this Amendment.

C. The Examiner asserts that with regard to Claim 20, it is not clear what structural limitation is added in this claim. The recitation: "board is a PGA type wiring board", is merely a label for the device, and not an actual structural limitation that distinguishes from the parent claim.

Applicants respond that the rejection is moot as claim 20 is now cancelled.

Claim Rejections -35 USC § 102(e)

Claims 13-16 and 20 stand rejected under 35 U.S.C. 102(e) as allegedly being anticipated by Miller et al. (US Patent No. 6,188,027) for the reasons given in the Office Action.

The Examiner apparently relies on Miller as disclosing the basic characteristics of a plated throughhole and holefill material.

Of particular note regarding Claim 13, the Examiner asserts that Miller teaches a throughhole which is filled with a paste (reference number 30) to be subjected to curing with a curing agent (column 5, line 62) and the curing agent is an imidazolic compound.

The Examiner further describes on page 5 of the Office Action the reasons why Miller allegedly anticipates Claims 14-16 and 20.

Of particular note regarding Claim 16, because the recitation, "at least part of the surface of the conductor layer has been subjected to a treatment of imparting hydrophobicity so that the treated surface part has a contact angle against water of 90 degrees or higher" is a product-by-

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process limitation, the Examiner considers that Applicants have the burden of proof to show that there is an unobvious difference between the claimed product having a conductor layer subjected to hydrophobicity treatment and the prior art product.

Applicants respond as follows.

Applicants' claimed invention is distinguished from the disclosure of Miller et al. The imidazole of Miller et al is an organic corrosion inhibitor which forms part of an adhesion promoter film formed on a plated throughhole (PTH) of the substrate (abstract, col. 3, lines 43-49 and claims 1, 4 and 5 of Miller et al). The adhesion promoter film which may contain an imidazole as a corrosion inhibitor is separate and distinct from the holefill material distributed within the PTH and including a resin (claim 1 of Miller et al). On the other hand, the throughhole-filling material of the present invention comprises, in admixture, a cured paste of an epoxy resin, a curing agent selected from imidazolic compounds represented by formula (1) and a metal filler.

Furthermore, Miller et al discloses a bilayer structure of the adhesion promoter film and the hole fill material, and therefore, is fundamentally different from the present invention.

In order to more clearly define their claimed invention, Applicants have amended claim 13 to recite that the throughhole-filling material comprises, in admixture, a cured paste of an epoxy resin, and a curing agent in a metal filler. This limitation is absent in the disclosure of Miller et al.

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Based on the foregoing arguments for traversal and clarifying amendment, Applicants respectfully submit that Miller et al does not anticipate each and every limitation of Applicants' claimed invention. Accordingly, Applicants request withdrawal of the anticipation rejection.

Claim Rejections -35 USC § 103

Claim 17 stands rejected under 35 U.S.C. 103(a) as allegedly being unpatentable over Miller et al.

Claims 18-19 stand rejected under 35 U.S.C. 103(a) as allegedly being unpatentable over Miller et al in view of Urasaki et al. (US Patent No.5,879,568).

Regarding Claim 17, the Examiner admits that Miller fails to explicitly teach that the treated surface part has a roughness: Rz of 0.3 to 20 μm . However, the Examiner asserts that it would have been obvious to have a desired roughness to improve the adhesion between elements in a circuit board. In addition, the Examiner asserts that the roughness variable is merely a result effective variable which involves only routine skill in the art to optimize.

The Examiner further asserts that the limitation: "at least part of the conductor layer has been subjected to a roughing treatment" is a product by process limitation which places the burden back on Applicants similar to the rejection of Claim 16.

Regarding Claims 18-19, the Examiner concludes that it would have been obvious to combine the teachings of Miller and Urasaki in order to have a substrate comprising a core substrate having on at least one side thereof a build-up layer formed by alternately laminating an insulating layer and a conductor layer alone (Claim 19), and also having the throughhole

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penetrate through both the core substrate and the build-up layer (Claim 18), thus improving the strength of the board.

Applicants respond as follows.

The recitation of the particular roughness characteristic in Applicants' claim is a material element of the Applicants' invention which is not disclosed or taught by the cited prior art, although roughening a surface to improve adhesion may be conventional. Again, building on the response above in traversing the §102(e) rejection, Miller et al. discloses an adhesion promoter film which is characteristically different from the Applicants' invention of roughening the conducting layer within a particular range which would remove the necessity for having an adhesion promoter film altogether. Therefore, Applicants traverse the Examiner's position on the basis that Miller et al does not disclose, suggest or make obvious such a preferred embodiment.

Furthermore, Applicants assert that the claimed invention provides unexpectedly superior results. The problem of developing a gap caused when a thoughhole-filling material containing a filler of base metal such as a copper powder can be avoided by using a curing agent of the claimed invention. Using a curing agent having a special structure as claimed can unexpectedly accelerate uniformity of the shrinkage behavior of an epoxy resin upon curing and effectively depress development of the gap.

Moreover, the rejection over Miller et al should be withdrawn based on previous arguments stated above. Therefore, the Examiner should not be able to combine Miller with

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Urasaki in rejecting claims 18-19 for at least all the reasons stated above. Accordingly, Applicants respectfully request withdrawal of the obviousness rejection.

Conclusion

In view of the above, reconsideration and allowance of this application are now believed to be in order, and such actions are hereby solicited. If any points remain in issue which the Examiner feels may be best resolved through a personal or telephone interview, the Examiner is kindly requested to contact the undersigned at the telephone number listed below.

The USPTO is directed and authorized to charge all required fees, except for the Issue Fee and the Publication Fee, to Deposit Account No. 19-4880. Please also credit any overpayments to said Deposit Account.

Respectfully submitted,


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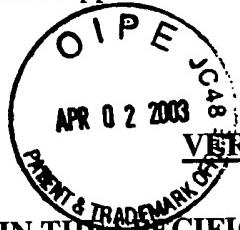


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PATENT TRADEMARK OFFICE

Date: April 2, 2003

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APPENDIX

VERSION WITH MARKINGS TO SHOW CHANGES MADE

IN THE SPECIFICATION:

The specification is changed as follows:

Please replace the paragraph on page 7 at lines 4-11:

In these drawings, 1 designates a core substrate, 2 a substrate, 3 an inside (wall) surface of a hole, 4 a conductor layer, 5 a roughed surface, 6 a hydrophobic surface, 7 a conductor layer surface, 8 a water droplet, 80 contact point of water droplet with the surface of a conductor layer surface, 81 the top of a water droplet, 82 a hypothetical line, 83 a horizontal line, 9 an angle (θ), 10 a cured throughhole-filling material, 11 a dent (d), and 12 a gap.

Please replace the paragraph on page 28 at lines 7-16:

A photoresist film is applied to the core substrate, followed by exposure and development to thereby provide an opening of 600 μm in diameter and an opening corresponding to the predetermined wiring pattern (not shown). The copper foil laid bare at the opening of the photoresist film is etched away using an etching solution containing sodium sulfite and sulfuric acid. The photoresist film is delaminated away to obtain a core substrate having the exposed portion [(300)] (301) as shown in Fig. 9 and the exposed portion corresponding to the predetermined wiring pattern (not shown).

Please replace the paragraph starting on page 33, line 24 through page 34, line 7:

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A semiconductor element (270) is disposed at a position where it can be mounted on the semiconductor-mounting side, and the assembly is passed through a solder reflow furnace under the temperature condition of only melting the low-melting solder to thereby mount the semiconductor element. After filling an underfill material (300) into the mounted portion using a dispenser, thermal curing is conducted to obtain a semiconductor device using an FC-PGA type multi-layer printed wiring board on which a semiconductor element is mounted as is shown in Fig. 7.

Please insert the following paragraph starting on page 34, starting at line 8:

Fig. 7 also shows a metal cover pad (170), a semiconductor die made of silicon (280), and metallic connecting pads (290).

IN THE CLAIMS:

Claims 1-12 and 20 are canceled.

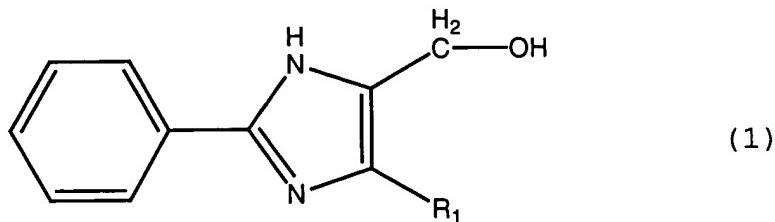
The claims are amended as follows:

13. (Amended) A printed wiring board comprising: a substrate having a conductor layer; and a throughhole penetrating through the substrate filled with a cured throughhole-filling material,

[wherein the throughhole is filled with a paste to be subjected to curing; the paste comprises] said cured throughhole-filling material comprising, in admixture, a cured paste of an epoxy resin, a curing agent and a metal filler; the metal filler is a powder which comprises a

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base metal; and the curing agent is an imidazolic compound represented by the following formula (1):



wherein R_1 is selected from the group consisting of [represents] a hydrogen atom, an alkyl group containing 1 to 10 carbon atoms, a hydroxyalkyl group containing 1 to 10 carbon atoms and [or] an alkyloxy group containing 1 to 10 carbon atoms.